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Sustainable Housing Supply in Nigeria Through the Use of Indigenous and Composite Building Materials

Abraham Taiwo[1]* Albert Adeboye[2]
1. Department of Architecture, Federal University of Technology, P.M.B. 704, Akure, Nigeria
2. Department of Architecture, Covenant University, P. M. B. 1023, Ota, Nigeria
*E-mail of the corresponding author: abraham_taiwo@yahoo.com

Abstract
Housing is one of the basic necessities of life after food. The need and importance of housing to cater for the ever increasing urban population in Nigeria is causing serious challenges to urban dwellers and the government. The high cost of conventional building materials in Nigeria is making the government and the private sector to look for alternative sources of building materials locally, in order to, meet the housing needs of the ever-increasing population. The paper highlights the combination of the use of stabilized earth blocks as an indigenous material for construction and composite building materials in Nigeria, and further stressed that the sustainability of these materials will drastically ameliorate the shortage of housing in Nigeria. Recommendations were made as to how these indigenous and composite building materials can be used to meet the housing needs of majority of the both rural and urban dwellers in Nigeria.
Keywords: Building, Composite, Indigenous, Materials, Sustainability

1. Introduction

Sustainable development can be described as that which meets the needs of the present, without compromising the ability of future generations to meet their own needs. This definition may not be immediately applicable to third world countries against the background of the level of housing provision. But it is a pointer that concerted efforts should be made by various national governments of these countries to phase out this transition period which should be based on ways of using the present earth's resources to more sustainable practice in the area of increasing housing stock. Most of the third world countries (Nigeria inclusive) are presently confronted with a relatively large deficit of housing requirements, a very high occupancy ratio in most cities, lack of basic provision of infrastructural facilities like pipe borne water, water closet, electricity and good road network. What then could be done in order to match growth with development in a developing country like Nigeria? There is a need to really establish what the problems are, how to find solutions to them and the best method that can be adopted to achieve a comfortable result within a limited time frame. Gilbert (2000) asserted that millions of the urban families in the Third World cities live in homes that lack adequate sanitation and security, have an irregular electricity supply and are built of flimsy materials. Millions of others live in more solid and serviced accommodation but in overcrowded conditions. Apart from the households living in shacks or overcrowded tenements and those lacking adequate services, millions more would claim to have a housing problem. They live in houses that do not match their hopes and needs: they have difficulty paying their rent or mortgage, they have a long journey to work, their home is too small, they wish to own a house rather than rent.

Gilkinson & Sexton (2007) stated that sustainable housing is a form of affordable housing that incorporates environmentally friendly and community-based practices. It attempts to reduce the negative impact that homes can have on the environment through choosing better building materials and environmental designs. The phenomenon of climate change and global warming has arisen from the continued emission of carbon dioxide and other Green House Gases into the atmosphere. The reduction of carbon dioxide emissions in house construction and domestic housing is thus a critical issue in environmental management. Consideration should also be given to the durability, permeability and buildability of defined material resources; the structures fixity, structural stability and acoustic attributes (Gilkinson & Sexton, 2007).

2. Sustainable development and housing provision

The United Nations Conference on Environment and Development – the Earth Summit held in Rio de Janeiro in 1992, created an international framework for the sustainable development of human settlements. In the conference, environmental issues and the natural environment became important guidelines for the realization of adequate shelter in the century. Prior to Rio de Janeiro international awareness, the techniques of handling the relationship between

ecology and the built environment had already become topical among governments and professionals. Architects, planners, environmentalists and engineers were sensitized on issues such as energy consumption, use of environmental friendly materials and design concepts that reduce environmental impacts and ensure sustainability.

Adedeji et al (2011), observed that sustainable housing provision is the gradual, continual and replicable process of meeting the housing needs of the populace, the vast majority of who are poor and are incapable of providing adequately for them. It ensures housing strategies that are stable and are not subject to vagaries in the political circumstances of the country. Sustainable housing provision requires proper definition of housing needs, and the participation of the end users to ensure their satisfaction. The general goal of sustainable development is to meet the essential needs of the world's poor while ensuring that future generations have adequate resources base to meet theirs. It is thus geared towards meeting the needs of the present generation without compromising the ability of future ones to meet their own needs. Arayela & Taiwo (2010), stressed that housing shortages have been recorded in both rural and urban communities of all African countries with the latter being more critical. Housing shortages are a worldwide phenomenon though, in most developing and some developed countries. It was against this background that the delegates at the 1976 United Nations Conference on Human Settlements (Habitat) in Vanconver, Canada, demanded a completely new and radical approach to housing policy. The policy was expected to have a strong political and financial commitment by governments especially in helping the poorest citizens of the world.

The rapid increase in the population of urban centres has resulted in an increase in the cost of living because of higher demand on urban commodities. There is a dearth and high cost of urban land, and high cost of housing, which is often in short supply and out of the economic reach of the majority of the urban households (Oladapo & Olotuah, 2010). The urban centers are populated by a large mass of people on low wage and who face irregular employment. This segment of the urban population is indeed poor, and is constrained to limited, insufficient, crowded, cold and dirty shelter and a generally degraded environment. These are the urban poor who are subjected to a life characterized by precarious conditions of nutrition and health, little or poor material possessions (Olotuah, 2010).

Housing the urban dwellers is one of the major challenges facing mankind in this century. Although studies have shown that the problem of housing is universal, it is however more critical in the third world countries, Nigeria inclusive. The challenge of housing the poor is particularly acute in the urban areas of less developed countries (LDCs) where an explosive expansion of the urban population due to a high population growth rate and massive rural-urban drift has compounded the housing situation (Olotuah et al, 2005a). In most instances, the urban poor live in over-crowded housing, often in self-made temporary structures in slums and squatter settlements where they exert unprecedented pressure on deteriorating urban infrastructure and social services (Omole, 2000). Nigeria has one of the highest urban growth rates in the world. The incidence of this population in urban centers has created severe housing problems, resulting in overcrowding in inadequate dwellings, and in a situation in which 60% of Nigerians can be said to be "houseless persons" (Olotuah et al, 2005a, 2005b).

To help reduce the cost of building materials in Nigeria and the rest of the Third World countries, building materials should be produced in large quantities and at low prices. Because market monopolies frequently dominate the production of cement, roofing, glass and steel, the real price of construction materials is constantly rising. Governments should also encourage the emergence of local suppliers of indigenous and composite building materials on a large scale.

3. Cement-bonded Composites Materials for Building

Cement-bonded particleboard is a value-added wood product made from the combination of two or more raw materials such as particles from wood and agricultural byproducts, cement and a catalyst. Cement-bonded board is produced from strands, particles and wood fibers mixed together with cement and manufactured into panels, brick tiles and other products used in the construction industry. Cement-bonded product can be classified into cement-bonded board, wood-wool excelsior boards and gypsum-bonded board. The excellent properties of cement-bonding make it useful for ceiling, walling, roofing, flooring, claddings, partitioning and shuttering. Cement-bonded boards can be applied for internal and external works as it is resistant to termites, insects, fungi, moisture movement, fire, and good insulating properties, durable and excellent nailing ability.

Ajayi (2005) asserted that cement-bonded composite has been accepted as panel products for construction works for interior and exterior purposes. The main interest in boards manufacture in Nigeria is associated with the availability in large quantities of the two major production variables (Portland cement and wood wastes) and the low cost of cement compared with that of the resin binder usually used in the production of resin-bonded particleboards. Wood

wastes of various grades (sawdust, off cuts, slabs, defective logs, thinning, pruning's and shavings) form the main raw materials base and such wastes are derived from wood processing and forest industries. Different agricultural residues are being used as raw materials for boards manufacture, for example Banana stem with saw dust (Ajayi 2003), Maize stalk (Ajayi, 2006a), bagasse (Sandermann, 1970, Simatupang et al, 1993), and coffee chaff (Ajayi, 2006b). The inherent excellent characteristics of cement-bonded boards, particularly its high resistance to moisture, fire, termites, fungi and other forms of degrading agents have made it versatile construction material for roofing, ceiling, flooring, partitioning, cladding and shuttering (Badejo, 1986; Dinwoodie and Paxton, 1990).

4. Use of stabilized building blocks for construction

One of such materials is unfired solid interlocking laterite / clay (Hydraform blocks) (Oti et al, 2009) otherwise known as stabilized earth blocks. The usage of stabilized blocks, in place of conventional fired bricks, can significantly reduce the energy use and also cut down CO2 emissions and minimize generated wastes (Joseph, 2010). Made largely from soil excavated on site, stabilized earth houses require substantially less fossil fuel–derived energy to build, than the conventional concrete buildings commonly found in many urban centers in Nigeria. Stabilized earth buildings help to ease pressure on the world's over-harvested forests. Laterite which constitutes more than 80 percent of the materials needed for the production of stabilized blocks is abundantly available in Nigeria. Materials used for its construction are collected locally: no huge mines are required to supply building materials, and the blemish produced when extracting laterite can generally be repaired quickly and easily with little environmental impact (Arayela, 1996). The ability of the Nigerian economy has not being buoyant enough to sustain importation and use of expensive building materials for construction works. Furthermore, some existing locally produced building materials are capital intensive to manufacture locally, as production of such materials are based on sophisticated technologies.

Construction of stabilized building techniques requires very little skill and is ideally suited to owner–building projects. You can learn what you need to know in a week–long workshop. Stabilized earth buildings can be quite economical, thereby further adding to their appeal. Usually, solid laterite blocks are produced on the site where the materials are available. Laterite soil with good grain size distribution and good cohesive performance is a good material for production of interlocking block, but the proportion of clay and aggregates has to be checked (Adedeji, 2011). Interlocking blocks are manufactured by hydraulically compressing a soil and cement mixture in a block-making machine. Where the material is unused, excess can recycled on site and reused.

The development of interlocking blocks (solid interlocking laterite blocks) shows some merits over the conventional types. First, substantial cost savings can be achieved due to elimination of binding mortar in the superstructure, thereby reducing workmanship. In this system freely-available subsoil is the main raw material and the blocks do not require costly burning; transport costs are minimized since production of Hydraform blocks takes place on site in hydraulic block machines, available from Hydraform International (Pty) Ltd., headquartered in Johannesburg, South Africa. In addition, speed of construction is a valuable feature of the system, which is much faster than other building methods (Adedeji, 2011).

Sustainable housing provision requires proper definition of housing needs, and the participation of the end users to ensure their satisfaction. The general goal of sustainable development is to meet the essential needs of the world's poor while ensuring that future generations have adequate resources base to meet theirs. It is thus geared towards meeting the needs of the present generation without compromising the ability of future ones to meet their own needs. Achieving sustainability in housing provision requires major societal changes, restructuring of institutions and management approaches. It requires the appropriate political will based on the conviction of the responsibility of government to its citizens, and the need to create humane and decent environment for dignified living. In order to realize sustainable housing provision the housing needs of the Nigerian population have to be put into proper focus, and a coordinated program to achieve this should be thoroughly worked out. With due consideration given to the input of the local communities, government may initiate aided self-help programs and low-cost core housing units. It can also facilitate the acquisition of building materials, the cost of which constitutes about 60% of the entire cost of a building. Production of building materials of indigenous origin by private investors should be given logistic and material support by government (see Figures 1&2). Figure 1 shows interlocking blocks being produced from laterite and used at the Obasanjo low-cost housing estate, Ado-Ekiti, Nigeria. While figure 2 shows the Electronic Testing Centre, Federal University of Technology, Akure-Nigeria. This building was built in 2008 with stabilized interlocking blocks.

5. Conclusion and Recommendations

This paper has been able to establish that there is an acute shortage of housing in both the rural and urban centers of Nigeria. For example, the National Housing Policy in Nigeria puts housing deficit at 8 million housing units as at 1991, while the shortage in 2012 is currently being estimated at 17 million housing units (NHP, 2012). The paper recognized the inability of the economy as not being buoyant enough to sustain importation and use of expensive building materials for construction works in Nigeria. It further noted that some existing locally produced building materials are capital intensive to manufacture locally, as production of such materials are based on sophisticated technologies. This, combined with transportation cost of materials to the site, usually increase the total cost of building construction.

The paper further revealed that materials used for construction of stabilized earth blocks are collected locally and that no huge mines are required to supply building materials, and the blemish produced when extracting laterite can generally be repaired quickly and easily with little environmental impact. Construction of stabilized building techniques requires very little skill and is ideally suited to owner–building projects.

The paper noted that laterite which constitutes more than 80 percent of the materials needed for the production of stabilized blocks is abundantly present in Nigeria. The technology required for its production is also very low, thereby reducing the overall cost for wall construction. The combination of the use of stabilized earth blocks as an indigenous material for construction and composite building materials when fully used in housing delivery will drastically ameliorate the shortage of housing in Nigeria. The paper therefore recommends that governments (Federal, States and Local), in alliance with Housing Authorities and allied professional bodies in the building construction industry, should, as a matter of deliberate policy, encourage the use of stabilized blocks and composite building materials, especially for simple residential construction works. It also recognized the need for radical steps to be taken to housing and a strong political backing by the governments at all levels to ensure success of the use of stabilized blocks and composite building materials. These measures hopefully would encourage many people to be directly involved in building their own houses and reduce substantially, governments' expenses on importation of some building materials into Nigeria.

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TAIWO Abraham was born in Dengi, Nigeria on 16th February 1961. He attended ECWA primary school in Jos between 1969 to1975, he then proceeded to Baptist High School also in Jos between 1976 and 1981. He then went to the University of Jos to study Architecture. He had his BSc. in 1987 and MSc. in 1990. He worked briefly with an Architectural Firm before joining Abubakar Tafawa Balewa University, Bauchi, Nigeria in 1993 as an Assistant Lecturer. He is presently a Senior Lecturer in the Department of Architecture, Federal University of Technology, Akure, Nigeria. Taiwo is a registered architect with the Architects Registration Council of Nigeria – ARCON. He bagged his Ph.D. in 2009. His research focus is on Urban Housing.

ALBERT B. Adeboye was born at Ife-Olukotun, Yagba East Local Government Area of Kogi State in Nigeria. His educational training spanned about thirty (30) years. After acquiring his primary education in 1970, he proceeded to obtain the City and Guilds Part I & II in Fabrication Engineering Craft Practice (1975 & 1976 respectively). In architecture, he obtained the National Diploma (1979), Higher National Diploma (1981), Bachelor of Science honours degree (1988) Master of Science (1990) and a Doctor of Philosophy (2009). His major research areas are Theory and History of Architecture, and Architectural Education and Practice.

Figure 1: Interlocking blocks, an indigenous material produced from laterite and used in Obasanjo low-cost housing estate, Ado-Ekiti, Nigeria.

Figure 2: Electronics Testing Centre, Federal University of Technology, Akure, Nigeria was built in 2008 with stabilized interlocking blocks